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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/813,892

Applicant(s)

COMLEY ET AL.

Examiner

Kevin P. Kerns

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 August 2007 and 24 September 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-12,16-23 and 36-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-12,16-23 and 36-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 March 2004 and 18 April 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date: _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 2, 4, and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Weisert et al. (US 4,882,823) in view of Salishchev et al. (the *Materials Science Forum* article "Characterization of Submicron-Grained Ti-6Al-4V Sheets with Enhanced Superplastic Properties" – corresponding to Cite No. 11 of the IDS dated April 21, 2004) and Movchan et al. (WO 95/13406).

Weisert et al. disclose a method of diffusion bonding and superplastic forming hollow components such as aircraft engine components (i.e. gas turbine compressor fan

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blades) (col. 1, lines 5-10). Weisert et al. disclose superplastically forming "reactive" metals including titanium (col. 3, lines 49-53) and further teaches a preferred material of Ti-6Al-4V superplastically formed at general temperature ranges including 1450°F-1750°F (col. 4, lines 15-18). Weisert et al. also teach diffusion bonding the preferred Ti-6Al-4V material at 25-300 psi for about 30 minutes (col. 4, lines 19 and 28). Weisert et al. disclose heating each blank to within a diffusion bonding temperature range of each blank (col. 4, lines 12-15), and diffusion bonding the first blank to the second blank (col. 4, lines 15-19 and 59-64). Furthermore, Weisert et al. disclose flat surfaces (14,20) positioned in abutting relation to each other to the opposite flat sides of the intermediate flat core sheet (24), and teach subjecting the sheets (12,18,24) to diffusion bonding conditions in appropriate tooling (27) to bond the flat surfaces (14,20) to each other or to the core sheet (24) other than where the stop-off material was applied, thereby forming a diffusion bonded sandwich (29) (col. 4, lines 56-64; and Figure 2B). Weisert et al. also disclose that superplastic behavior enhances formability under compressive strain conditions (col. 3, lines 47-49). Therefore, the properties and method of Weisert et al. are substantially similar with that of the applicants' claimed invention that it would be necessarily present to arrive at the specified strain rates of claims 11 and 12. However, Weisert et al. lack disclosure of specific grain sizes for the titanium blank and a diffusion bonding temperature of less than 1450°F.

However, Salishchev et al. disclose a superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained (i.e. grain size of less than or about 1 micron -- see page 441, 1st paragraph under Introduction) and has enhanced superplastic properties of

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temperatures below 1450°F (specifically, 550°C on page 441, 1st paragraph under Introduction), with strain rates ranging from at least about 5×10^{-4} per second to 1×10^{-2} per second, such that this superplastic titanium alloy (Ti-6Al-4V) is subjected to a superplastic forming/diffusion bonding (SPF/DB) process to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination (Salishchev et al.; pages 441-446; and Tables 2 and 3). In addition, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that there are general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the applicants' invention was made to modify the method of diffusion bonding and superplastic forming hollow components such as aircraft engine components, as disclosed by Weisert et al., by using the superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained and has enhanced superplastic properties of temperatures below 1450°F, as taught by Salishchev et al., in order to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination (Salishchev et al.; Abstract and Introduction of page 441; and Summary of page 446).

Weisert et al. in view of Salishchev et al. lack specific disclosure of superplastically forming the titanium alloy blanks at a temperature of less than 1450°F.

However, Movchan et al. disclose superplastic deformation of titanium alloy blanks at temperatures between 650-760°C (1202-1400°F), and includes Ti-6Al-4V as an example of such a titanium alloy (Movchan et al., p. 3, lines 22-26 and p. 5, lines 28-31). Thus, it would have been obvious to arrive at a common superplastic forming temperature between 1400°F and 1450°F based on the combined disclosures of Weisert et al., Salishchev et al., and Movchan et al. (claim 10). Movchan et al. also disclose strain rates for superplastic formation of titanium alloy of at least about 6×10^{-4} per second and 1×10^{-3} per second (Movchan et al., p. 5, lines 30-31).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the applicants' invention was made to modify the method of diffusion bonding and superplastic forming hollow components such as aircraft engine components, as disclosed by Weisert et al., by using the superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained and has enhanced superplastic properties of temperatures below 1450°F, as taught by Salishchev et al., in order to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination, and by further including the specified superplastic formation temperatures and strain rates, as disclosed by Movchan et al., in order to superplastically form titanium blanks at temperatures where oxidation is not a problem, inclusive of ambient atmospheres (Movchan et al.; p. 3, lines 24-26).

4. Claims 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Weisert et al. (US 4,882,823) in view of Salishchev et al. (the *Materials Science Forum* article "Characterization of Submicron-Grained Ti-6Al-4V Sheets with Enhanced Superplastic Properties" – corresponding to Cite No. 11 of the IDS dated April 21, 2004) and Movchan et al. (WO 95/13406), and further in view of Stacher (US 5,118,026).

With respect to claims 5 and 6, Weisert et al., Salishchev et al., and Movchan et al. lack disclosure of pickling the surface of the workpiece to remove any formed oxide during the superplastic forming step.

However, Stacher discloses the fabrication of titanium aluminide sandwich structures that combines the process of metal joining and superplastic forming (col. 3, lines 26-29). Stacher states that titanium is particularly sensitive to oxygen, nitrogen, and water vapor content in the air at elevated temperatures (col. 2, lines 33-35). Stacher further teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al. to include the pickling step of Stacher, in order to remove an accurate amount of oxide to obtain the maximum obtainable joint strength (Stacher; col. 2, lines 50-53) and to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36).

With regard to claim 7, Stacher teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55). Thus, with the combined invention of Weisert et al., Salishchev et al., and Movchan et al., and Stacher, it would have been obvious to arrive at the claimed pickling rate. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al., to include the pickling step of Stacher, in order to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36).

Regarding claim 8, Stacher teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55). Thus, with the combined invention of Weisert et al., Salishchev et al., Movchan et al., and Stacher, it is obvious to arrive at the claimed amount of oxide to be removed from the surfaces. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al., to include the pickling step of Stacher, in order to remove an accurate amount of oxide to obtain the maximum obtainable joint strength (col. 2, lines 50-53).

With respect to claim 9, Stacher teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55).

It is noted that Weisert et al. disclose the average thickness of the diffusion bonded sandwich between 5 mils (thousands of an inch) and about 150 mils (Weisert; col. 5, lines 6-10). Thus, with the combined invention of Weisert et al., Salishchev et al., Movchan et al., and Stacher, it would have been obvious to arrive at the claimed thickness. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention to include the thickness of Weisert et al., in order to obtain a uniform mass distribution (thickness) of the sheets and therefore prevent rupturing of the truss core during superplastic forming (Weisert; col. 5, lines 16-19), and further to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al. to include the pickling step of Stacher, in order to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36).

5. Claims 16-23 and 36-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Weisert et al. (US 4,882,823) in view of Salishchev et al. (the *Materials Science Forum* article "Characterization of Submicron-Grained Ti-6Al-4V Sheets with Enhanced Superplastic Properties" – corresponding to Cite No. 11 of the IDS dated April 21, 2004), Movchan et al. (WO 95/13406), and Stacher (US 5,118,026).

With respect to claim 16-19, 21-23, 36-39, 41, and 42, Weisert et al. disclose a method of diffusion bonding and superplastic forming hollow components such as aircraft engine components (i.e. gas turbine compressor fan blades) (col. 1, lines 5-10). Weisert et al. disclose superplastically forming "reactive" metals including titanium (col.

3, lines 49-53) and further teaches a preferred material of Ti-6Al-4V superplastically formed at general temperature ranges including 1450°F-1750°F (col. 4, lines 15-18). Weisert et al. also teach diffusion bonding the preferred Ti-6Al-4V material at 25-300 psi for about 30 minutes (col. 4, lines 19 and 28). Weisert et al. disclose heating each blank to within a diffusion bonding temperature range of each blank (col. 4, lines 12-15), and diffusion bonding the first blank to the second blank (col. 4, lines 15-19 and 59-64). Furthermore, Weisert et al. disclose flat surfaces (14,20) positioned in abutting relation to each other to the opposite flat sides of the intermediate flat core sheet (24), and teach subjecting the sheets (12,18,24) to diffusion bonding conditions in appropriate tooling (27) to bond the flat surfaces (14,20) to each other or to the core sheet (24) other than where the stop-off material was applied, thereby forming a diffusion bonded sandwich (29) (col. 4, lines 56-64; and Figure 2B). Weisert et al. also disclose that superplastic behavior enhances formability under compressive strain conditions (col. 3, lines 47-49). Therefore, the properties and method of Weisert et al. are substantially similar with that of the applicants' claimed invention that it would be necessarily present to arrive at the specified strain rates of claims 22, 23, and 42 and the specified "about 1425°F" of claim 21. However, Weisert et al. lack disclosure of specific grain sizes for the titanium blank and a diffusion bonding temperature of less than 1450°F.

However, Salishchev et al. disclose a superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained (i.e. grain size of less than or about 1 micron -- see page 441, 1st paragraph under Introduction) and has enhanced superplastic properties of temperatures below 1450°F (specifically, 550°C on page 441, 1st paragraph under

Introduction), with strain rates ranging from at least about 5×10^{-4} per second to 1×10^{-2} per second, such that this superplastic titanium alloy (Ti-6Al-4V) is subjected to a superplastic forming/diffusion bonding (SPF/DB) process to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination (Salishchev et al.; pages 441-446; and Tables 2 and 3). In addition, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that there are general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the applicants' invention was made to modify the method of diffusion bonding and superplastic forming hollow components such as aircraft engine components, as disclosed by Weisert et al., by using the superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained and has enhanced superplastic properties of temperatures below 1450°F, as taught by Salishchev et al., in order to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination (Salishchev et al.; Abstract and Introduction of page 441; and Summary of page 446).

Weisert et al. in view of Salishchev et al. lack specific disclosure of superplastically forming the titanium alloy blanks at a temperature of less than 1450°F.

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However, Movchan et al. disclose superplastic deformation of titanium alloy blanks at temperatures between 650-760°C (1202-1400°F), and includes Ti-6Al-4V as an example of such a titanium alloy (Movchan et al., p. 3, lines 22-26 and p. 5, lines 28-31). Thus, it would have been obvious to arrive at a common superplastic forming temperature between 1400°F and 1450°F based on the combined disclosures of Weisert et al., Salishchev et al., and Movchan et al. (claims 21 and 41). Movchan et al. also disclose strain rates for superplastic formation of titanium alloy of at least about 6×10^{-4} per second and 1×10^{-3} per second (Movchan et al., p. 5, lines 30-31).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the applicants' invention was made to modify the method of diffusion bonding and superplastic forming hollow components such as aircraft engine components, as disclosed by Weisert et al., by using the superplastic titanium alloy (Ti-6Al-4V) that is submicron-grained and has enhanced superplastic properties of temperatures below 1450°F, as taught by Salishchev et al., in order to obtain complex-shaped components out of titanium alloys with enhanced mechanical properties, reduced processing tool costs, and material savings due to reduced contamination, and by further including the specified superplastic formation temperatures and strain rates, as disclosed by Movchan et al., in order to superplastically form titanium blanks at temperatures where oxidation is not a problem, inclusive of ambient atmospheres (Movchan et al.; p. 3, lines 24-26).

The combined disclosures of Weisert et al., Salishchev et al., and Movchan et al. lack disclosure of pickling the surface of the workpiece to remove any formed oxide during the superplastic forming step.

However, Stacher discloses the fabrication of titanium aluminide sandwich structures that combines the process of metal joining and superplastic forming (col. 3, lines 26-29). Stacher states that titanium is particularly sensitive to oxygen, nitrogen, and water vapor content in the air at elevated temperatures (col. 2, lines 33-35). Stacher further teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al. to include the pickling step of Stacher, in order to remove an accurate amount of oxide to obtain the maximum obtainable joint strength (Stacher; col. 2, lines 50-53) and to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36).

With regard to claims 20 and 40, Stacher teaches that the surfaces require preparatory cleaning (i.e. pickling) (col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (col. 2, lines 53-55). Thus, with the combined invention of Weisert et al., Salishchev et al., and Movchan et al., and Stacher, it would have been obvious to arrive at the claimed pickling rate. It would have been obvious to one of ordinary skill in the art at the time of

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the invention to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al., to include the pickling step of Stacher, in order to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36). It is noted that Weisert et al. disclose the average thickness of the diffusion bonded sandwich between 5 mils (thousands of an inch) and about 150 mils (Weisert; col. 5, lines 6-10). Thus, with the combined invention of Weisert et al., Salishchev et al., Movchan et al., and Stacher, it would have been obvious to arrive at the claimed thickness. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention to include the thickness of Weisert et al., in order to obtain a uniform mass distribution (thickness) of the sheets and therefore prevent rupturing of the truss core during superplastic forming (Weisert; col. 5, lines 16-19), and further to modify the combined invention of Weisert et al., Salishchev et al., and Movchan et al. to include the pickling step of Stacher, in order to remove an accurate amount of oxide to obtain the maximum obtainable joint strength (Stacher; col. 2, lines 50-53) and to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher; col. 3, lines 30-36).

Response to Arguments

6. The examiner acknowledges the appellants' Appeal Brief and supplemental Appeal Brief received by the USPTO on August 21, 2007 and September 24, 2007,

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respectively. Upon further review, the appellants' remarks/arguments are persuasive.

Claims 1, 2, 4-12, 16-23, and 36-42 remain under consideration in the application.

7. In view of the appellants' remarks/arguments in the Appeal Brief filed on August 21, 2007, PROSECUTION IS HEREBY REOPENED, as set forth in above the above 35 USC 103(a) rejections.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

/Jonathan Johnson/

Jonathan Johnson

SPE, Art Unit 1793

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Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin P. Kerns whose telephone number is (571) 272-1178. The examiner can normally be reached on Monday-Friday from 8:00am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jonathan Johnson can be reached on (571) 272-1177. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Kevin P. Kerns *Kevin Kerns 12/6/07*
Primary Examiner
Art Unit 1793

KPK
kpk
December 6, 2007